National
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Design Arts Program
A publication presenting information and ideas related to federal design

Managing Facts and Concepts

Computer Graphics and Information Graphics from a Graphic Designer's Perspective

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Computer Graphics and Information Graphics from a Graphic Designer's Perspective

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Based on a presentation in the first Federal Design Lecture Series, National Gallery of Art, Washington, DC, 20 November 1979

Preface

This monograph is the fourth publication in the Federal Design Library series. The Federal Design Improvement Program of the National Endowment for the Arts presents these monographs to enable managers and designers in federal service and in the private sector to access proven, useful tools and ideas important to the performance of their work. *Managing Facts and Concepts* includes two points crucial to understanding graphic design and communication.

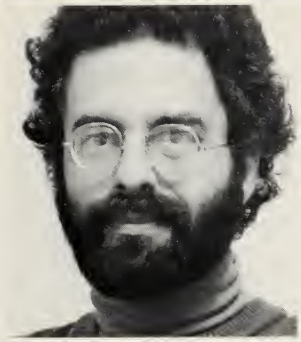
First is the clear idea that *graphic design is visual communication,* not just "beautification." The language of visual communication used by graphic designers, from symbols and signs to type, color, spatial composition and sequencing, is a vocabulary for which no common dictionary exists, yet one which is constantly in the making. Aaron Marcus investigates this vocabulary and suggests the need for clarity and consistency.

The second point is the idea of *using existing technology and exploring the potential of new technology to communicate information effectively.* The availability of electronic communication media is a known fact, but the full meaning of electronic communication of information is yet to be developed. Mr. Marcus shows us the route to distinguishing useful tools from distracting toys.

This monograph is a departure from the earlier manuals in this series because it deals with underlying conceptual issues of communicating information graphically. To some degree it helps manage the use of the earlier manuals in this series. It continues the theme of the series, to provide practical information, by providing access to publications and organizations that can assist the reader in achieving effective solutions to communicating complex information.

Prof. Lance J. Brown, R.A.
Coordinator, Design Excellence Project, 1979-82
Design Arts Program
National Endowment for the Arts

About the Author



Aaron Marcus is a graphic designer with fifteen years of experience in information graphics and computer graphics. He taught at Princeton University for nine years, was the University's graphic designer, and was a consultant in computer graphics at Bell Labs, Murray Hill, NJ, where he programmed a prototype interactive page design system for Picturephone use.

As a Staff Scientist at Lawrence Berkeley Laboratory, he is assisting the design of Seedis, a minicomputer-based geographic information management system funded by the US Departments of Labor and Energy. His expertise lies in developing effective formats and graphic design specifications for computer-generated texts, tables, charts, maps, and diagrams; for the design of the user-machine interface; and for program visualization and documentation.

Mr. Marcus has received awards and grants from the National Endowment for the Arts, Icograda, the Fulbright Scholarship, the East-West Center, the Art Directors Club of New York, and the Type Directors Club of New York. He has consulted with or lectured at international computer graphics research and development centers. He is a tutorial lecturer for the National Computer Graphics Association and the Special Interest Group on Graphics of the Association for Computing Machinery. His work has been shown in a special two-person exhibit at the American Institute of Graphic Arts, New York, and in galleries and museums in the USA, Europe, Israel, and Japan.

He has published two monographs distributed by the West Coast Poetry Review Press, *Soft Where, Inc., Volume 1 and 2,* which document his conceptual telecommunication artworks of the 1970's. He is the co-author of *The Computer Image* published by Addison-Wesley, a book produced by Polaroid on computer graphics. His articles and work have appeared in major graphic design and computer graphics journals. He is the head of Aaron Marcus and Associates, a consulting firm for computer-based graphic design.

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Introduction

This book emphasizes the importance of graphic design for an information-oriented society. In an environment in which many new graphic communication technologies are emerging, it raises some issues which graphic designers and managers of graphic design production should consider in using the new technology effectively. In its final sections, it gives an example of the steps taken in designing a visual narrative as a prototype for responsible information-oriented graphic design.

The management of complex facts and concepts, of complex systems of ideas and issues, presented in a visual as well as verbal narrative or dialogue and conveyed through new technology will challenge the graphic design community in the coming decades. This shift to visual-verbal communication has repercussions in the educational system and the political/governance systems that go beyond the scope of this book. If there is a single goal for this book, it is to stimulate the reader and then to provide references that will help you learn more about graphic design in an era of communication when "know business" is "show business."

Information Graphics and the New Technologies

People want to know "what's happening." They need to know what's going on, and they want to understand *why*. Who are these people? In one group are policy makers, managers, researchers, and technical/professional people. In another group is the general public: families, relatives, friends, and most of the people of the earth. Technology permits an ever greater flow of information between and within these groups. Senders and receivers both face the problem of determining which messages are valid, which are useful, which are *significant*. Information is not necessarily valid, useful, or significant.

Today a familiar problem has taken on new dimensions: How can we show what we know?

How can we see patterns in a busy, fuzzy reality? The new technologies of computer graphics and visual telecommunications have perfected the means of giving us information quickly, providing it inexpensively, and most importantly, displaying it for us dynamically. New opportunities are emerging for making invisible things visible, for making more of the learning process visual not only verbal, and for extending our abilities to understand the phenomena of the world.

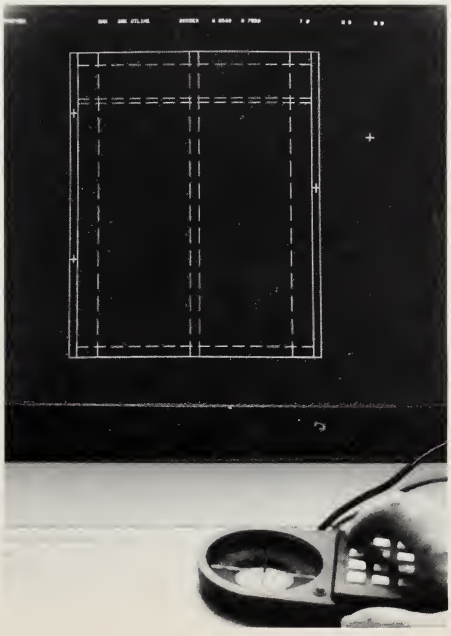
Of special importance are diagrams, maps, charts, and tables that can convey essential information more quickly and effectively than lengthy texts. The means for portraying facts and concepts in this format reside in conventional, as well as in advanced computer graphics displays of information. The term "computer graphics" is used in a very general sense. It implies data processing as well as display and includes the technologies of word processing, phototypesetting and the graphic arts, and video or cathode ray tube (crt) display.

Techniques for displaying informational graphics in the research, marketing, and management sectors of business and government are already available. From even the simplest alphanumeric computer terminals, it is now possible to get *images of information.* Advertisements for the most elaborate of the computer graphics devices promise a world of radiant color, of dazzling information, an "informational Las Vegas." Computer graphics systems can display raw data, or facts. They can also display policy data, that is, actions or concepts related to decision making. They can even display political data, that is, the data for implementing decisions. Throughout business and government, computer graphics technology is developing decision support systems with graphics for professional people, for managers, for policy makers, and, occasionally, for the general public. Computer-assisted charting and mapping will make the need for effective visual communication stronger and clearer.

1

Exhibit I
Corporate data (as of February 28, 1978)

2



This decade will bring into being the electronic or paperless office. That work place may be in a business, a government building, a research laboratory, a school, or even a home. The emerging network systems such as videotex services[1] in the work place of the future will enable us to send and receive information rapidly around the world via computer terminals. These systems will create an environment that theoretically permits mass distribution of information and the conditions for a marketplace of information.[2] In this marketplace, vendors will compete to provide the information that we need and supply it in the format that we prefer.

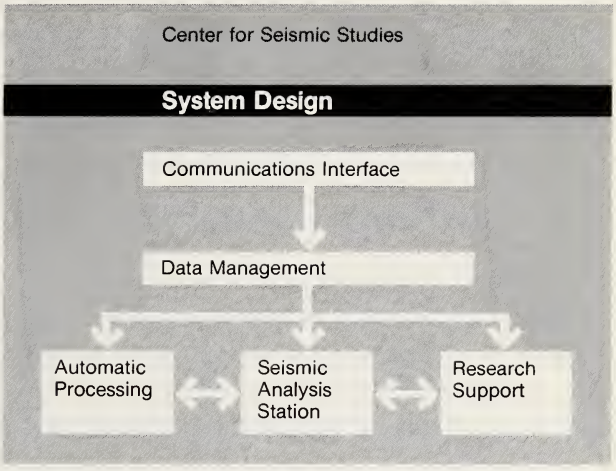
The past two decades have been called the "Information Age." The new decade should be called the "Image of Information Age." The signs of the new era are clearly apparent. Figure 1 shows a page of conventionally produced graphics[3] that reduces a 150-page executive report to a *single* sheet of 20 charts. These charts can be easily created, reproduced, distributed, comprehended, and updated.

Figure 2 shows an example of an interactive page design system. The system allows the creation of complex typographic displays for conventional publications or electronic media.[4] Imagine such a system combined with an innovation called Metafont[5] that allows people to design their own symbol systems and to use them in typesetting. These new developments suggest an environment of increasingly complex and flexible visual communication of information.

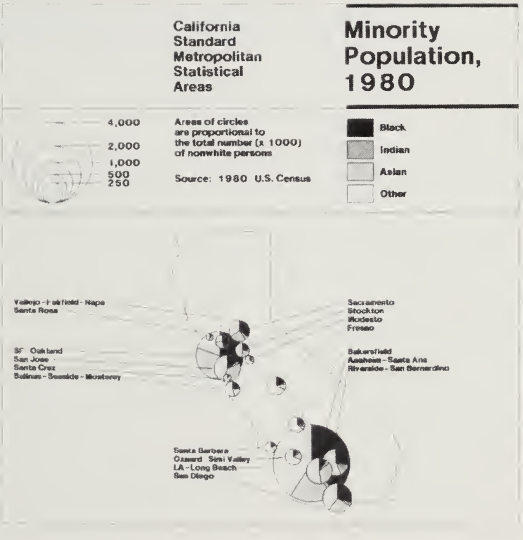
Two Approaches to Computer Graphics

Informational computer-assisted graphics systems can be divided into two groups. Figure 3 shows one kind in which elaborate color, high quality typography, and extensive non-alphanumeric symbols are available.[6] This represents the kind of computer-assisted informational graphics that might be called the "pretty but dumb" variety. If we wish to change automatically the organization of the chart by adding a new component, it might

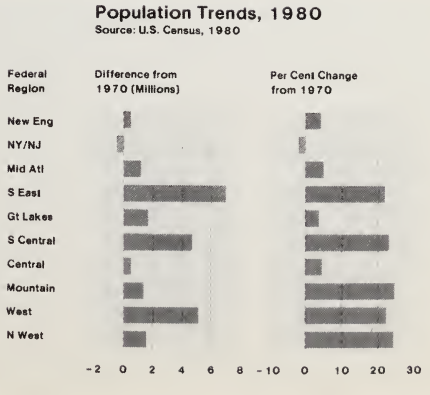
3


Center for Seismic Studies
System Design
Communications Interface
Data Management
Automatic Processing
Seismic Analysis Station
Research Support

4a


California Standard Metropolitan Statistical Areas
Minority Population, 1980
4,000
2,000
1,000
500
250
Areas of circles are proportional to the total number (x 1000) of nonwhite persons
Source: 1980 U.S. Census
Black
Indian
Asian
Other
Vallejo - Fairfield - Napa
Santa Rosa
SF - Oakland
San Jose
Santa Cruz
Salinas - Seaside - Monterey
Sacramento
Stockton
Modesto
Fresno
Bakersfield
Anaheim - Santa Ana
Riverside - San Bernardino
Santa Barbara
Oxnard - Simi Valley
LA - Long Beach
San Diego

4b


Population Trends, 1980
Source: U.S. Census, 1980
Federal Region
Difference from 1970 (Millions)
Per Cent Change from 1970
New Eng
NY/NJ
Mid Atl
S East
Gt Lakes
S Central
Central
Mountain
West
N West
-2 0 2 4 6 8
-10 0 10 20 30

be impossible in such a system. There is no data information space "behind" this kind of image for semantics (what symbols mean), only a display information space for syntax (how symbols are arranged). The image is only a "pretty face." Nevertheless, such images are an important kind of commercially available computer-assisted informational graphics often used for audio-visual slide presentations.

Figure 4 shows another kind of graphics. These are output images from an information management system like that of Seedis developed at Lawrence Berkeley Laboratory.[7] Such a system can semi-automatically display charts and maps that are sometimes less sophisticated in color and typography. However, the system has the advantage that someone can retrieve, change, and display the data in a variety of ways. The image may be "plain but smart."

Eventually the capabilities of these two approaches to displaying information graphics will merge as is now occurring in Seedis. The average user of information display systems will be able to manage the appropriate form of display, moving from coarse to refined data processing and display qualities as necessary. Most importantly, the user will be able to manage large amounts of information in a way that will express their content and significance in forms that are intelligible and appealing. This may end an era of "dull data" and herald the beginning of an age of "beautiful information." Both delights and dilemmas lie ahead.

Stumbling toward Utopia

From much of the vendor literature and the mass media, it might seem that a computer graphics Utopia is just around the corner. However, there remain formidable challenges to developing effective means of presenting information graphically. First of all, there is the task of collecting appropriate, valid data, of managing and massaging gigantic masses of data, of structuring them for easy access, and then of constructing and

distributing this information through conventional media or electronic networks. As we enter an era of mass information distribution, some people are concerned that humanistic and aesthetic values may be overlooked, forgotten, or ignored when systems are created that are dependent on the imagination and expertise of computer science and technology alone.

Assuming that all the technical/functional problems of computer-assisted informational graphics have been solved, one nagging question remains: How should data, facts, and concepts be presented? For many situations, the information itself may be too technical for professional or general audiences. What format should one use? How should typography and color be employed? How should everything be arranged?

In many of the informational graphics created through advanced computer-graphics systems, the typography is very primitive and ineffective; color is overused and lacking in control. There are often problems of visual indexing, of cross-referencing, of comparing one kind of information with another, of showing the reliability, precision, and age of information. In many advertisements for computer-graphics information display equipment, the very images that hardware and software vendors use reveal inadequate visual thinking, visual quality, and visual communication.

One picture may be worth a thousand words, numbers, dollars, or seconds of our time, but images must convey concepts as well as facts. How do we get across concepts? How do we make a meaningful image of information? A quick inspection of commercial advertisements will remind us that rapid transfer of concepts goes on in advertising all the time. How can this effectiveness be linked to databases and to computer graphics, not only persuasive graphics? Can it be done without introducing distortions and unnecessary appeals to the emotions? Answers to these questions will emerge in this decade.

The Look of the Future

What will the Image of Information Age be like? One set of images from informational graphics displays can give us an impression of this exciting and challenging new age.

Figure 5 shows a scene from the Spatial Data Management System developed at the Massachusetts Institute of Technology.[8] In this computer graphics display, it is possible to "fly" through information spaces, to penetrate many layers in which we can place or observe symbols that arise from representation of data. Imagine that we are in a 40-story building with a thousand elevators connecting various combinations of floors. In such an environment, we would need a signage system or a map to find our way through that complicated structure. To design graphics for an architecture of information is a significant task for graphic design in the last decades of the twentieth century.

Figure 6 shows an image from a "Cybernetic Landscape" that I programmed a decade ago as an interactive, aesthetic environment.[9] We may now understand it as a three-dimensional "bar chart landscape" in which we can fly about within an information space to learn something from it because of our position, velocity, and orientation in that space. Special symbols above the viewing window guide our own movement through this information space. This image suggests the possibility of electronic three-dimensional information graphics environments in which we can browse. We might even discover the presence of others "among the stacks" of an ephemeral library from whom we may inquire advice.

Electronic media predominate in this discussion of the future, but the problems of and need for quality graphic design of complex, often technical information exist right now in conventional media. Solutions to *current* problems are available through *conventional* means. For example, there is a need for better informational graphics throughout the many departments of the Federal

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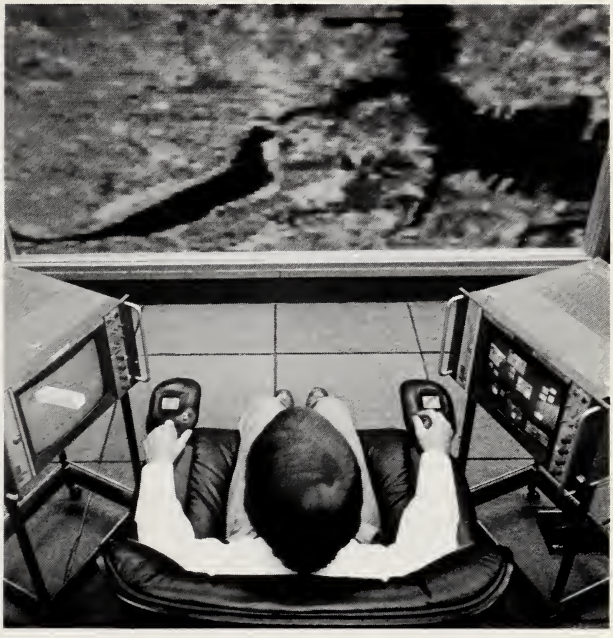
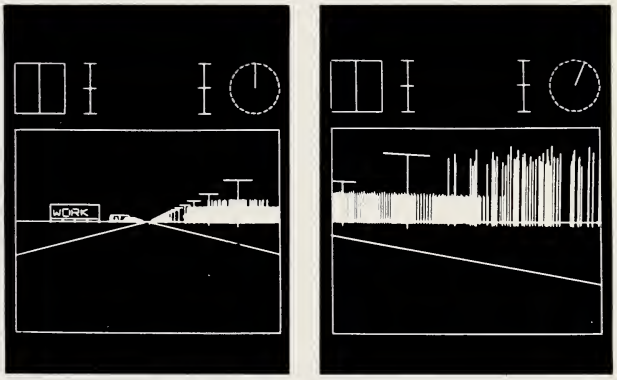
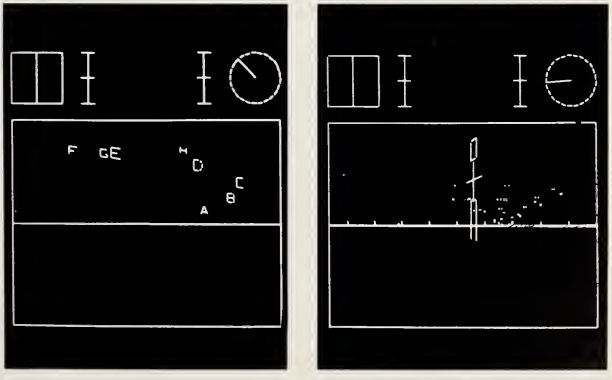


6a



6b



Government: in its internal and external publications, in its business forms, and in its public-oriented literature. Improving the graphic design of information is a "bottom-up" approach to graphic design problems rather than the typical "top-down" corporate design program which cleans up and redesigns corporate logos and stationery. Solving these conventional informational graphics problems may help us to design better electronics-based systems in the future.

Graphic Design in the Late '80s

The preceding sections are brief sketches of some of the visual characteristics of graphic design relevant to a new information-oriented society. In doing so we have glossed over the problems and procedures of developing ways to image complex information and to tell a story about that information with these images. The next section reviews a project that raises issues which the designer of responsible, effective information graphics must address. More and more information-oriented graphic designers will be called on to design narratives or dialogues for which there may be few precedents. Responsible solutions will acknowledge the needs of clients or senders or information, the audience or receivers, the content of the message, and the media used to convey it. Responsible graphics will require research, interdisciplinary teamwork, and patience over long periods of development and testing. These are characteristics of a new stage in the process of graphic design as a mature discipline within an information society.

An Example

This section discusses, the structure and development of an information-oriented project in graphic design. The project as a whole demonstrates how graphic designers can be involved with emerging informational graphics systems. This project concerned the need to communicate visually information about global interdependencies.

The Problem

How would *you* explain a complex subject like global interdependence to someone? Policy makers spend considerable time examining tables of numbers, texts, and complicated charts trying to understand this subject. In its institutes of population, communication, natural resources, culture learning and environmental planning, the East-West Center in Honolulu, a federally funded research center set up by Congress, explores the themes of global interdependence. Global interdependence involves all means of exchanging physical commodities such as food and gold, as well as exchanges of culture, finance, and technology.

The East-West Center decided to explore the possibility of new non-verbal means to discuss global interdependence. It invited five visual communicators from around the world to become research fellows and to study the problem of visualizing global interdependencies. Their backgrounds were Japanese, Indian, Persian, Chinese and American. The primary graphic design synthesis of the project resulted from the efforts of the author who was also the project co-ordinator and the following people:[10]

Mr. Yukio Ota, research fellow and graphic designer, the Advanced Social Planning Institute, Tokyo.

Ms. Susan Marcus, graphic designer, formerly free-lance designer for the Publications Office, Princeton University and currently head of Meta-Graphics, an information-oriented graphic design studio, Berkeley, California.

Mr. Jerry Kuyper, graphic designer, formerly Assistant Professor, University of Hawaii, and currently graphic designer in the studio of Saul Bass and Associates, Los Angeles, California.

Stages of Research

Our group had five months to consider and devise a way to visualize global interdependencies. In

the first stage of our research, we studied the general topic of global interdependence. Although there were people at the Center with specialized knowledge about individual topics, we had to formulate our own synthesis of the subject.

One approach we formulated derived from computer-based global planning models.[1] We discovered that these are extremely quantitative and too complex. Parenthetically, we also realized that effectively visualizing these global models is itself an extremely interesting and challenging graphic design task.[12] Global planning models tend to emphasize the so-called "hard" forms of global interdependence, ones that involve concrete, measurable exchanges in such fields as energy, food, population, trade, technology, labor, and financial aid. These models tend to overlook aspects of life that are less easy to measure and to define, for example, communication, education, values, politics, religion, and language.

In the second stage of research, our group considered three primary areas for further study: population, communication and energy. We selected energy because the images and the experts from the East-West Center were available readily. The topic of energy seemed understandable, relevant, and attractive. Our attention shifted to numerous reports such as that from the Workshop on Alternative Energy Strategies,[13] other research studies, and literature from the oil companies about the coming world crisis in energy. The material we studied was fascinating, disturbing, and confusing.

It was confusing because similar data were not always treated in the same way. Data were presented with varying degrees of certainty. Crucial data sometimes were missing. Conflicting implications sometimes were drawn from the same data on the shift from nonrenewable forms of energy to renewable forms such as solar and nuclear. We organized and clarified what information we could gather in the time available to us.

Finally, we arrived at the third stage of our research, studying the means of visualizing facts and concepts. Our group studied diagrams, maps, charts, tables, photographs, and models. We examined books, films, slide shows, and computer graphics.

Objectives and Procedures

Many of the graphic presentations that we examined displayed an ill-composed selection of visual images. Most of them appeared to have been created as verbal narratives with the visual material added later to assist the continuity of the narrative, to reinforce some points, and to keep the viewer alert. Our goal was to reverse the standard visual-verbal relationship, to make the images primarily responsible for conveying clearly determined concepts. We sought to create a *signage system for the mind that would lead a viewer through a complex conceptual landscape.*

What we ultimately achieved was an experiment in visualization, not a new theory of global interdependence. The main goal was to achieve exemplary coherence, clarity, and visual impact. As an example of what we wished to create, we often referred to a book and a film that have achieved much deserved fame in the informational graphics community. The book is *Cosmic Views* by Kees Boeke on which the Eames studio based its film *Powers of Ten.*[14] Portions of the book appear in Figure 7. Both the book and the film illustrate what it means to jump orders of magnitude from the size of the electron to the size of the entire universe in approximately 40 steps of a "conceptual zoom." Our objective was to achieve the same clarity and impact as the book/film. Another guide for our project was the late John McHale's *World Facts and Trends,* a book that tries to visualize many diverse but significant facts and concepts about the world.[15]

We considered several graphic media for the project, such as a brochure, film, video program, and poster series. We eventually decided to create a

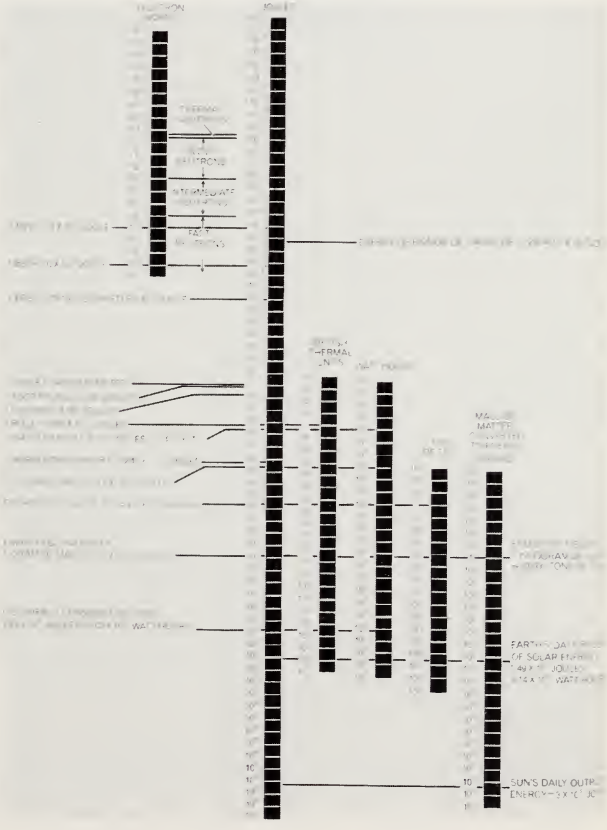
slide show, because slide projection facilities are available in most places and are simpler than film or video. Through this medium, we intended the presentation to be available in developing as well as in developed countries. With a slide show we could achieve large images with strong visual impact that could be changed relatively easily, updated, and duplicated. One final advantage of a slide show over books and posters would be the fact that viewing a slide show naturally encourages people to gather together for further discussion about the content and form of the presentation.

The complexity of the subject matter and the necessary discussions, planning, and review of concepts and facts during the first two stages of research meant that we had only six weeks to produce the slide show. Originally, we considered creating a 30-minute slide show with multiple screens, but the amount of work in understanding the subject matter and determining the right images required us to reduce the scale of our original intentions to a single series of images for half the time. From our earlier research, we developed a concept list of about 200 entries. We reordered and reduced this list to about 100 entries, a workable sum for a single screen 15-minute slide show. Then came the verbal-visual leap: How could we move from this list of verbal items to images? What pictures, diagrams, and symbols could we use?

A Critique of Exemplary Images

It is appropriate to review some of the charts and maps that we examined. Many of these images raised interesting points; many were potentially valuable. A crucial question for us was not simply how good or bad each was by itself but how continuity and clarity could arise in a *sequence* of many images.

7
8



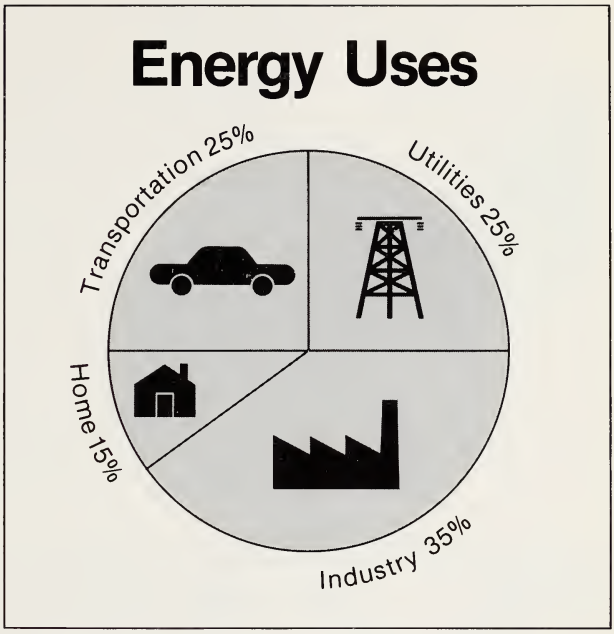
Consider the diagram in Figure 8 from *Scientific American,* a magazine that is generally an excellent source for informational graphics.[16] The chart relates various energy units, but unfortunately for our use, it does not include two of the most-often used units of energy in political and planning circles, i.e., metric tons of coal equivalent and millions of barrels per day of oil equivalent. A diagram converting one discipline's units into another seemed an interesting idea and potentially effective visual tool.

For any kind of data, thousands of forms are possible. Pie charts, for example, are often used to show gross differences, but it is sometimes difficult to make cross comparisons from pie chart to pie chart. The illustrative quantities of Figure 9 are perhaps suitable for secondary school audiences. Does this image "humanize" data or make information more friendly? Some people think so, but others caution against the use of "chart junk" and specifically warn against the use of pie charts.[17]

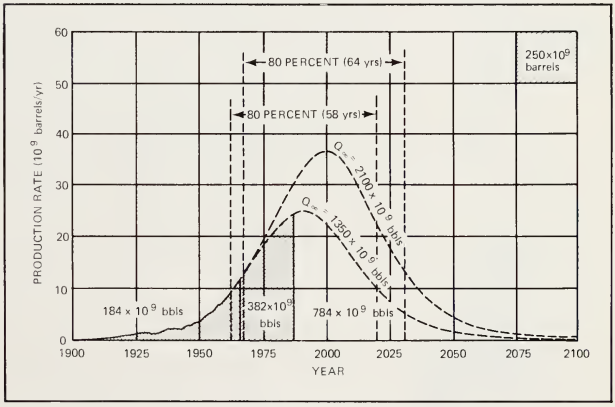
In any list, bar chart, or other diagram form, there is a general limit to giving more than five major things to consider at any one time. Many numbers presented at once cannot be easily remembered, and in an audio-visual presentation, there is very little time to understand a frame of information. Many diagrams that we examined had too many data or reference points for our use. They were better suited for use in publications rather than audio-visual presentation. Unfortunately, many professional people lecture with slides made from copies of published charts and maps; these images are often very inappropriate for slide presentation.

As an example, consider Figure 10, a line chart that is too complicated visually. The heaviness of the grid lines disturb the viewer's ability to read

9


Energy Uses
Transportation 25%
Utilities 25%
Home 15%
Industry 35%

10


80 PERCENT (64 yrs)
80 PERCENT (58 yrs)
250×10⁹ barrels
Q = 2100 × 10⁹ bbls
Q = 1350 × 10⁹ bbls
184 × 10⁹ bbls
382×10⁹ bbls
784 × 10⁹ bbls
PRODUCTION RATE (10⁹ barrels/yr)
YEAR
0
10
20
30
40
50
60
1900
1925
1950
1975
2000
2025
2050
2075
2100

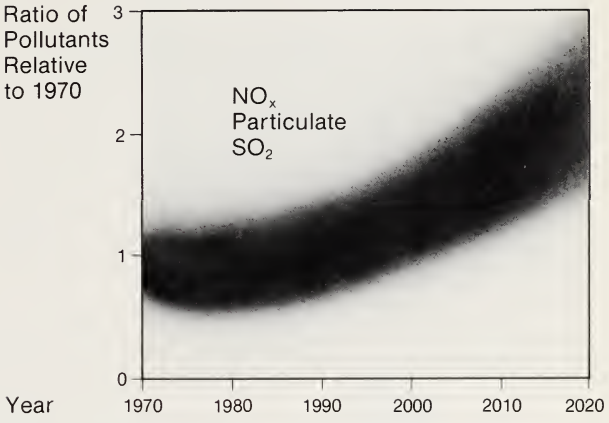
the significant information. The evenness in the size, weight, and location of typography make it difficult to know which items are most important, and the scale of the typography make the chart unsuitable for reproduction at a reduced scale in a journal. Figure 11 is much better: it is easy to read, invites examination, poses fewer distractions. Two other qualities in this chart are worth noting. First, the data line "looks like" the subject of the chart. It is "iconic", to use the terminology from visual semiotics.[18] Second, it is not easy to determine exactly where the line is being drawn. That may very well indicate the reliability of the data. Charts often mistakenly give an impression that the data are more certain than is the case.

Figure 12 is an important flowchart that diagrams the total input/output flow of energy in the United States.[19] The part at the top right reveals the fact that half the energy entering the energy system of the United States is eventually lost. This energy produces nothing useful; it is radiated as heat. Computer programs have been written to display this kind of chart but these computer-assisted diagrams are hard to read because of typesize, color area patterns, and line weights. Complex images like this one are not easy to display effectively for a professional audience. They are certainly difficult to create for a mass audience; yet, the educational or consciousness-raising potential of a diagram such as this one might be considerable if it were well designed, clear, and frequently encountered.

The diagram in Figure 13 is typical of a "crisis diagram."[20] Where is the crisis? This chart does not help the reader find out quickly. For example, "Surplus" appears in the small shaded black and white area, while "Demand" appears in black. These terms are opposites, but that relationship is not apparent from the visual coding of the chart. One problem with this chart is that *everything* is rather interesting and exotic in terms of color and pattern. There are too many changes in background and too many boxes for titles. The

11

Environmental Pollution Problems



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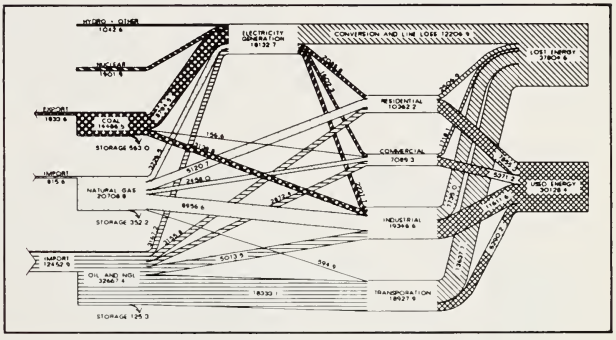

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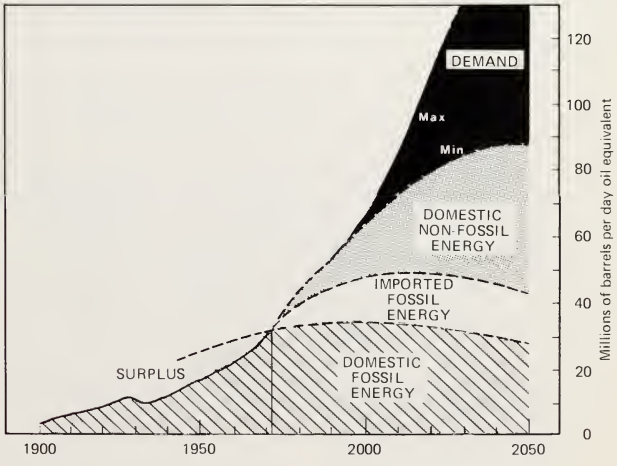

fundamental visual "crisis" is the lack of a clear hierarchy of information.

Maps are an important means of showing spatial data, facts, and concepts. Figure 14 shows a map of global oil flow encountered in discussions of energy interdependence. The map from *Scientific American,* seems legible and readable without distracting color and lines. Note the use of pictographic symbols to assist the reader.[21] Figures 15 and 16 indicate other approaches to mapping.

Figure 15 is an overly sophisticated image; the area of the land masses is proportional to the population, the height to the gross national product per capita, and the volume to the total GNP.[22] It is not easy to grasp the relative volumes of these solids. Note another curious and undesirable feature of this map/chart: the legend is almost as massive and visually important as the primary content of the image.

Figure 16 comes from a commercial advertisement.[23] Because the message is relatively simple the image can easily be clear and forceful. Informational graphics need to strive more assertively toward this exemplary clarity. The figure is a kind of cartogram, a map with very strong visual impact usually created through computer graphics assistance. Maps such as this have helped to create new images of the world, just as the first photos of the earth from space helped to change our global perspective. Although the cartogram is a powerful, distinctive image, it presented a problem for our project. How could we combine this kind of image with other kinds of images in a sequence? To achieve visual continuity, we eventually chose more conventional maps to portray geographic information.

In Figures 17-19 are typical examples of presenting information through computer graphics.[24] Such displays are most valuable for the analysis of very complex and elaborate technical data, but it takes time to learn how to read this kind of imagery. In fact, at least one representative of a

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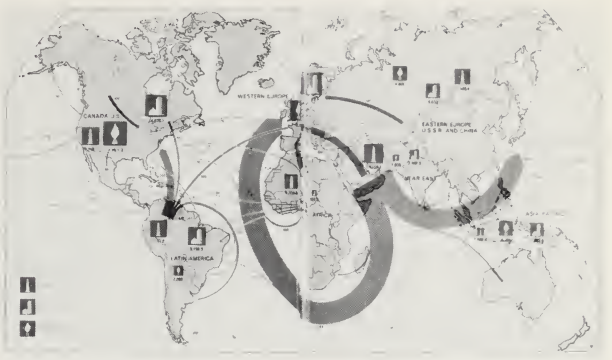

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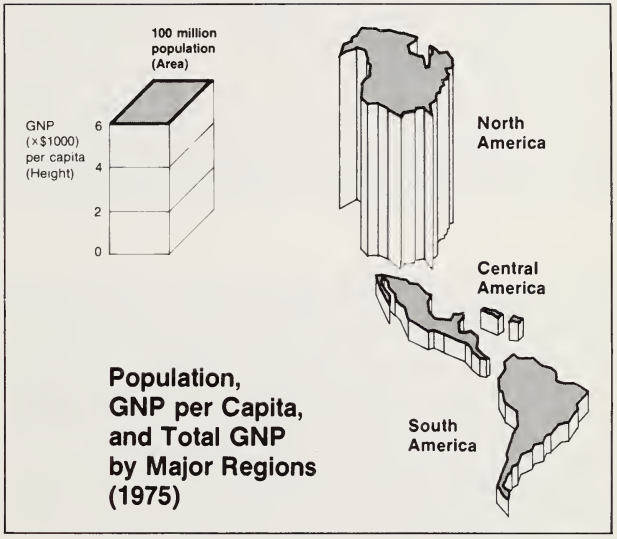
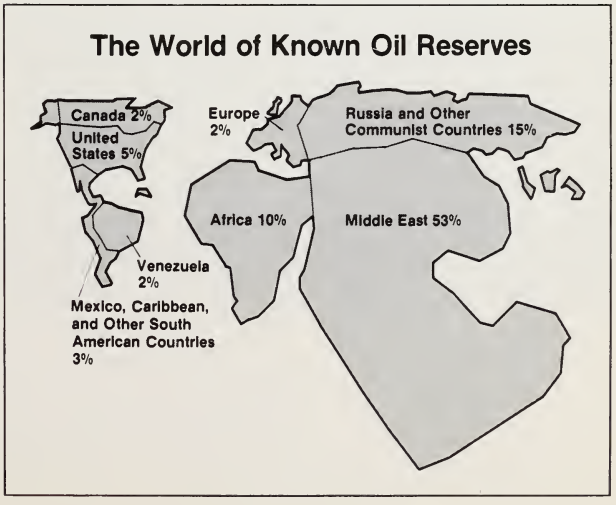

100 million population (Area)
GNP (×$1000) per capita (Height)
6
4
2
0
North America
Central America
South America
Population, GNP per Capita, and Total GNP by Major Regions (1975)

16


The World of Known Oil Reserves
Canada 2%
United States 5%
Europe 2%
Russia and Other Communist Countries 15%
Africa 10%
Middle East 53%
Venezuela 2%
Mexico, Caribbean, and Other South American Countries 3%

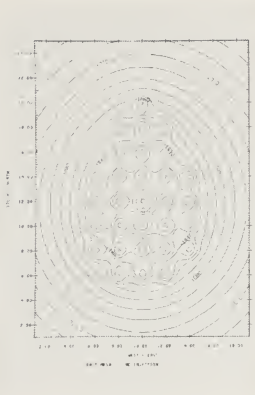
computer graphics research group has said that he could not be certain how successful such images are as communication even for technical audiences looking at them in an audio-visual or lecture presentation. The form of these diagrams needs to be considered carefully in presentations to technical audiences. They must also be planned and designed carefully for professionals from another discipline or for the public. Unfortunately, typography, color, and composition are often not as effective as they should be in these diagrams. One other factor to note is that it takes considerably more time than usual to program these displays properly if one is demanding about the *quality* of visual images.

Our research/design group also examined photography as a natural means of visualizing global interdependencies. We discovered that photography can readily picture the objects being discussed, that is, the *nouns* of a visual presentation. The problem for us was to show the *verbs* and to assemble nouns and verbs into integrated chains of concepts in a visual narrative. It would have required an impossibly large budget to travel around the world to create or acquire sufficient images. Instead, as a supplementary task of our project, we collected a few hundred excellent slides from several thousand examples and categorized these according to the concepts we developed. In this way we created for the East-West Center's lecturers and publications an image bank of high quality slides on specific topics of global energy interdependence.

Compiling a photographic image bank would have been a very fine visual editing task, but we also wanted to create new images. We still considered it possible to combine our photographic thematic catalog with our final project at a later time.

The Final Result

For the final form of our project, selections of which are shown in Figures 20-27,[25] we decided to experiment with an approach radically different from most of the material we examined. We



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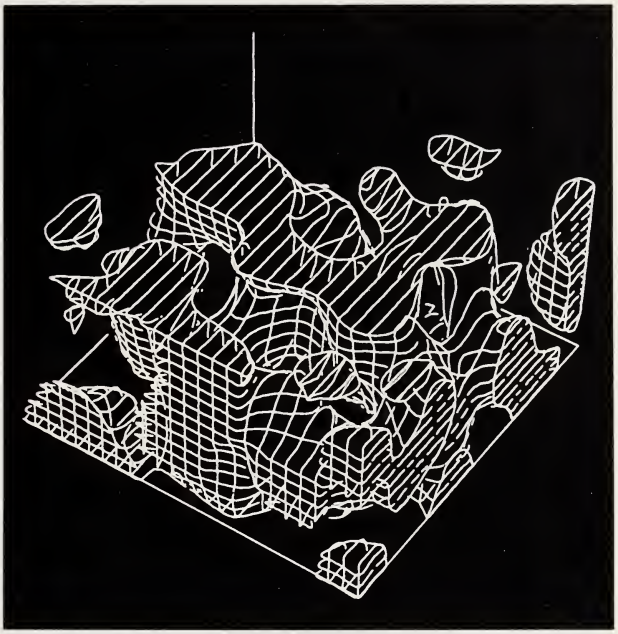

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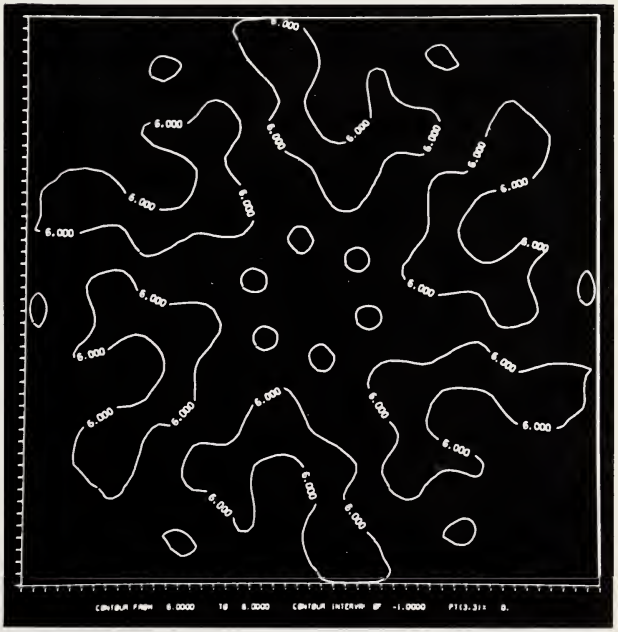
19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CONTOUR FROM 6.0000 TO 6.0000 CONTOUR INTERVAL OF -1.0000 PT(3,3)= 0.

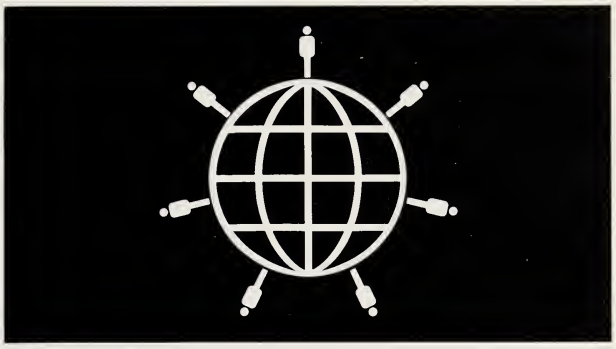
created a nonverbal symbol/chart/diagram/map system. We developed a new pictographic/ideographic "language" to simplify and clarify reality. Our approach was not new; it was based on systems of international signage[26] and Isotype symbols[27] as well as proposals for universal visible languages. In the latter group are, Bliss symbols[28] and LoCos.[29] Universal visible languages may have no standard spoken form, but it is possible to write and read them easily and to communicate almost anything that might otherwise be spoken.

We studied thousands of symbols from glossaries and books. Eventually, we sketched about 500 pictograms or ideograms and created approximately 200 composite images. We reduced this collection by careful selection to about 70 signs and combined these into approximately 80 images.

Because we were developing the presentation for a multicultural audience, we were hesitant about the use of color. If we wished to say that something is holy or sacred, what color should we use? Should it be white, black, saffron yellow, red, or green? Specific color connotations are a very complex matter. Designers of clothing as well as designers of signage systems for international airports know this quite well. We decided to create our show in black and white; black itself would be a color. In addition, a white on black show would stand out in a milieu of audio-visual presentations that is often characterized by an overabundance of ill-designed color.

We wanted to restrict the use of any verbal material because we did not want to stress left-to-right English language-oriented images. For the same reason we tried to compose centered figure-field relationships wherever possible. These would not emphasize a particular left/right reading direction. We also studied symbol size variations. We determined that we needed symbols with three primary sizes, in effect title, text, and footnote sizes, because we were

20



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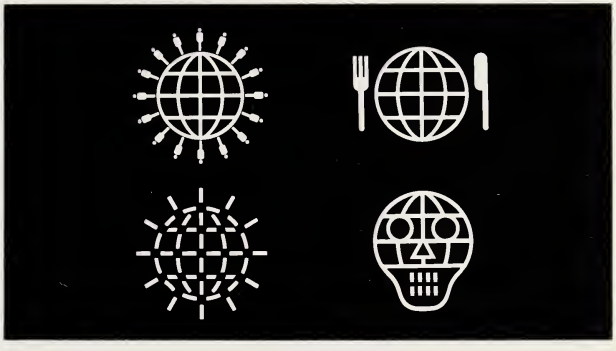

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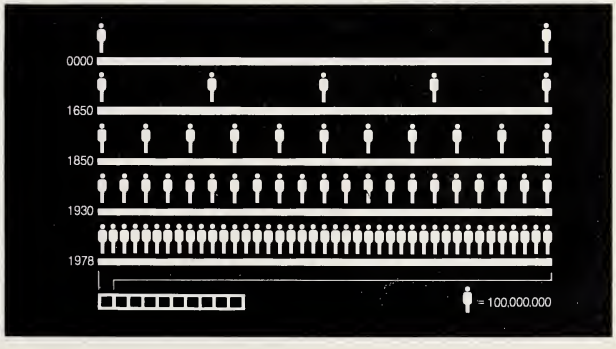
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1650
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23

Consumption
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9
10
11
>1000 x 10 MTCE
200-900
= <200
MTCE = Metric Tons
of Coal
Equivalent

defining a "typography" of pictographic/ ideographic symbols.

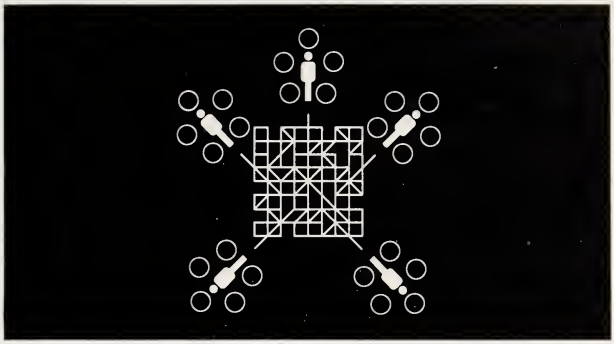
We revised our symbols and compositions continually, always seeking an ideal resolution to the needs of form and content. At the very last moment, we added a sound track. We designed a musical score that seeks to balance Eastern and Western themes. As a fail-safe feature, we wrote a brief verbal (English) narration. This development sequence reverses the traditional flow in which the verbal narrative comes first. In some audio-visual presentations, it is possible to turn off the slide projector and to understand most of the information content from the sound track. Our presentation was the opposite. What we finally achieved is a visual symbol/chart/map narrative similar to primitive symbol stories or the pictographic/ideographic writing of some civilizations.

This visual narrative is composed of three segments. The first discusses global interdependence generally. The second focuses on energy interdependence as an example. The third returns the viewer to the perspective of general global interdependence. Because of this structure, it would be possible to discuss other specific topics in the same symbol system by designing a new second section.

The symbol system itself is modular. We designed the symbols for use in this slide presentation format, but also for charts, exhibits, publications, lectures, and reports. Since the symbol system has evolved, it has already been used in a variety of ways at the East-West Center.

The presentation was shown several dozen times in semi-final format to audiences in the United States, India, and Japan. Written evaluations and informal comments were used as a basis for adjustments in its final form before the slide show was prepared for distribution by the East-West Center as a filmstrip for educational use.[30]

24



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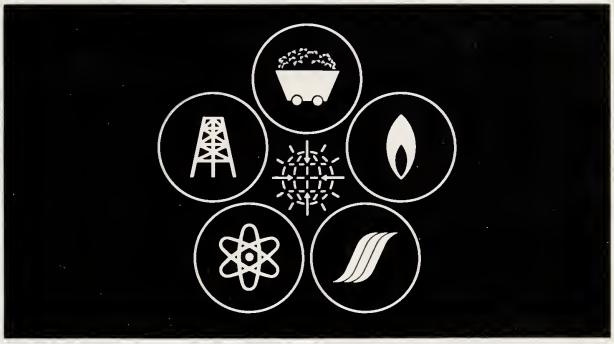

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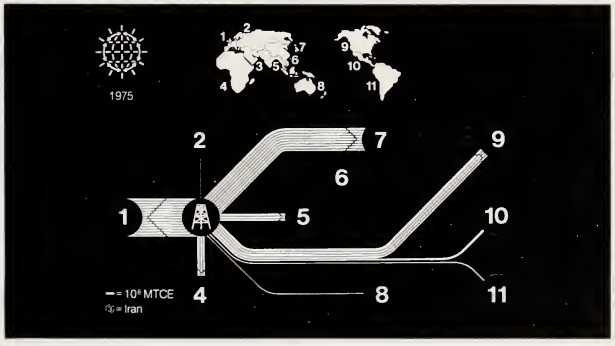

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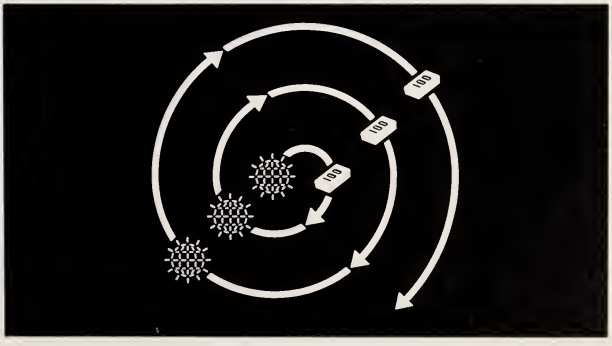

"Visualizing Global Interdependencies" is an attempt to communicate both facts and concepts, to go beyond numbers to link ideas, to create a balance between specific data and abstract information. The sequencing of symbols must introduce the symbol language and, at the same time, assist the viewer in learning to think with that system.

These white symbols against a deep, black field show the stark reality of global interdependence without distracting decoration. In a dark room, facts, concepts, and the significance of global interdependencies leap forward to confront a viewer's consciousness and conscience.

Summary and Conclusions

I began this monograph by describing the changes taking place in graphic communication and its relation to an information-oriented society. I then explained the "Visualizing Global Interdependencies" project, a visual communication project typical of the challenges facing the graphic design community in the coming decades.

As we all attempt to make our way through an increasingly complex information environment, information-oriented graphic designers must help to define and clarify complex systems, to help give a coherent, comprehensible, and appealing "face" to important information that may otherwise not be appreciated, understood, or used. In this short monograph, I can only highlight the subject matter of information-oriented graphic design and computer graphics.

I have also indicated broadly a new role for graphic designers in the Image of Information Age. Information-oriented graphic design spans a wide body of expertise in visual design and communication, the visual arts, and science/technology. Graphic design can help manage the visual communication of facts and concepts so

vital to an information society. Responsible information graphics will require from everyone involved a delicate balance of professional experience (the hand and the eye), professional method (the intellect or mind), and professional principles (the heart).

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12 This task has been taken on in a subsequent East-West Center project, "Development Prospects for the Pacific Basin to the Year 2000," cofunded by the Design Arts Program of the National Endowment for the Arts. In it a graphic designer has worked with a research team as a peer during 1979-82 to develop diagrams of global models. These diagrams are an effective visual interface between computer scientists and mathematicians on the one hand and policy makers on the other. The diagrams of several global models are so constructed that each model can be easily compared with other models. See Susan Marcus, "Diagramming Complex Systems," *Information Design Journal,* 1:3, 1980, pp. 167-173.

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20 The Figure is an adaptation from a chart whose source is not known.

21 The Figure is adapted from a chart appearing in "The Annual Report" of the World Bank, 1978.

22 The Figure is adapted from an advertisement of Exxon Corporation.

23 The source for these Figures is the Computer Science and Mathematics Department, Lawrence Berkeley Laboratory. Figures reproduced with the permission of Lawrence Berkeley Laboratory.

24 The images appeared in *Perspectives,* Journal of the East-West Center, Summer 1979, pp. 15-22. Figures reproduced with the permission of East-West Perspectives Magazine, East-West Center, Honolulu, HI.

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Magazines and Journals

The following publications contain articles on information-oriented graphic design and computer graphics.

Byte: The Small Systems Journal, (covering home and small business computer systems), Post Office Box 590, Martinsville, NJ 08836.

Computer Decisions (aimed at managers), Post Office Box 13802, Philadelphia, PA 19101.

Computer Graphics and Applications (covering the current state as well as the near term future of computer graphics technology), 10662 Los Vaqueros Circle, Los Alamitos, CA 90720.

Datamation (a primary computer trade magazine), 666 Fifth Ave., New York, NY 10019.

Infoworld (a weekly newspaper for computer technology), 375 Cochituate Road, Box 880, Framingham, MA 01701

Information Design Journal (information-oriented graphic design), Post Office Box 185, Milton Keynes MK7 6BL, Great Britain.

Output (for the new data processing layperson), 666 Fifth Avenue, New York, NY 10019.

Visible Language (scholarly journal of the visual media of language expression), Cleveland Museum of Art, Cleveland OH 44106.

Conferences

Dozens of major national conferences in information science and in computer graphics take place each year. The graphic design student, professional, and manager need to be aware of these meetings as a source of important new developments relevant to information-oriented graphic communication. The following is a list of the more general conferences. The magazines and journals listed above will alert the reader to others in their calendars of events. The locations of these conferences circulate throughout the USA. The addresses of the conveners of the conferences are given, and inquiries should be directed to them.

American Society for Information Science, 1010 16th Street, N.W., Washington, DC 20036, 202-653-3644. This very large conference has many technical and application-oriented special interest groups.

Human Factors Society, Post Office Box 1369, Santa Monica, CA 90406. This group represents ergonomics and applied psychology. Subject matter of interest includes symbol systems, information display, and computer graphics systems.

National Computer Graphics Association, 8401 Arlington Boulevard, Suite 601, Fairfax, VA 22031, 703-698- 9600. Their large conference and tutorials are a business- and government-oriented gatherings on computer graphics, graphic arts, and telecommunication.

Special Interest Group on Graphics (SIGGRAPH), Association for Computing Machinery, 11 West 42nd Street, New York, NY 10036. This large conference and tutorial is academically oriented but covers many important applications.

West Coast Computer Faire, 333 Swett Road, Woodside, CA 94062. Their conference and equipment display is one of the largest. The Faire is oriented to personal and hobby computers and computer graphics.

In addition to these national conferences, scores of tutorial and smaller conference organizations have sprung up to provide continuing professional education. Among many of immediate relevance to graphic design are the following:

Institute for Continuing Studies in Design, Management and Communication, School of Design, College of Design, Architecture, Art, and Planning, University of Cincinnati, Cincinnati, Ohio 45221, 513-475-6828. The Institute's week-long

studio seminars (including equipment demonstrations) for designers, writers, editors, and managers emphasize the role of the new technology. The Center for Design Arts Technology, an Institute project, participates in the seminar programs.

The Datamation Institute for Information Management and Technology Research, 850 Boylston Street, Chestnut Hill, MA 02167. Their courses cover most major computer graphics techniques, including business graphics, computer-aided design and manufacturing, and mapping.

National Computer Graphics Association Tutorials, 2033 M Street, N.W., Suite 330, Washington, DC 20036, 202-466-4102. Their tutorials are oriented toward the practical needs of a wide variety of computer graphics users or potential users.

Institute for Graphic Communication, Inc., 375 Commonwealth Avenue, Boston, MA 02115. Their small scale conferences (a few hundred people at a West Coast and East Coast retreat) feature business and government oriented sessions on state of the art technology in computer graphics, word processing, video, graphic arts, etc.

Design and the Information Environment, c/o Minneapolis College of Art and Design, 133 East 25 Street, Minneapolis, MN 55404. This annual conference for graphic designers concerns computer graphics and information graphics issues.

Pratt Center for Computer Graphics in Design, c/o Perry E. Jeffe, Director, 505 White Plains Road, Tarrytown, NY 10591. The Center presents a variety of limited attendance, design-oriented seminars at several sites in the U.S.

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About these Publications

This book is one of a series that includes three others of special importance to professionals in communication:

Design Standards Manuals: Their meaning and use for federal designers, by Bruce Blackburn, explains what a design standards manual is and how this tool can be used to develop efficient, economical publications.

Grids: Their meaning and use for federal designers, by Massimo Vignelli, demonstrates the use of the grid in graphic design layout.

Photography for Graphic Designers, by Norman Sanders, analyzes the characteristics of good photography and shows how to judge a photograph for reproduction.

These books are publications of the National Endowment for the Arts. To obtain a copy, write to The Design Arts Program, National Endowment for the Arts, Washington, DC 20506.

Studio seminars are sponsored by the National Endowment for the Arts as a part of the Design Arts Program's Design Excellence Project (formerly the Federal Design Improvement Program). The seminars give federal designers, and editors the opportunity to keep abreast of the latest techniques and methods in design and communication, to solve problems and to exchange ideas. Participants include designers, their supervisors, photographers, illustrators, typographers, editors, and printing officers. The seminars are conducted by the Institute for Continuing Studies in Design, Management and Communication, c/o Nicholas Chaparos, Director, School of Design, University of Cincinnati, Cincinnati, Ohio, 45221, 513-475-6828 or 1112 6th Street, N.W., Washington, D.C. 20001, 202- 289- 4838.

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